

Electrodynamic Dust Shield for Lunar/ISS Experiment

Completed Technology Project (2014 - 2016)



Project Introduction

The Electrostatics and Surface Physics Laboratory at Kennedy Space Center is developing a dust mitigation experiment and testing it on the lunar surface and on the International Space Station (ISS). The Electrodynamic Dust Shield (EDS) clears dust off surfaces and prevents accumulation by using a pattern of electrodes to generate a non-uniform electric field over the surface being protected. The EDS experiment will repel dust off materials such as painted Kapton and glass to demonstrate applications for thermal radiators, camera lenses, solar panels, and other hardware and equipment.

The EDS uses a pattern of electrodes to generate a "wavelike" electric field that pushes dust off surfaces. Dust particles in the vicinity of the EDS electrodes experience a dielectrophoretic force generated by the non-uniform electric field around the electrode grid. This dielectrophoretic force depends on the square of the electrostatic potential difference between adjacent electrodes and the inverse cube of the electrode geometric parameters, such as electrode separation. Thus, for a given force, a decrease in the electrode separation results in a substantial decrease in the voltage required to operate the EDS.

Two configurations will be tested: (1) copper electrodes on Kapton film adhered to an aluminum panel to simulate dust expulsion on thermal radiators and (2) transparent indium tin oxide electrodes on a glass panel to simulate use on optical equipment (i.e., camera lenses). Configurations 1 and 2 will be tested on ISS. Configuration 2 will also be mounted to the footpad of a commercial lander and tested on the lunar surface.

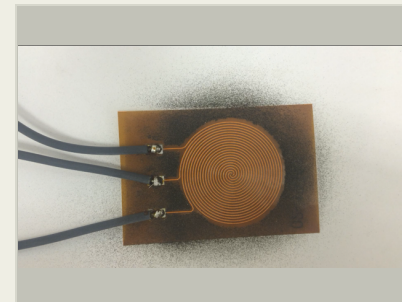
Anticipated Benefits

The EDS is considered the best non-contact active dust mitigation technology for space applications. Other technologies, such as piezoelectric-based vibrating membranes are not as effective at removing fine dust.

Dust control and removal from surfaces is of crucial importance for robotic missions to and asteroid, Mars, and the moon. Dust removal is needed for equipment to operate and for solar panels and radiators to operate efficiently. Controlled dust motion is required to bring regolith for sampling and to deliver regolith to science instruments.

Benefits as mentioned above.

Dust removal from optical systems for U.S. commercial space industry. Equipment operating in dusty environments such as the lunar or Martian surfaces.



Copper-on-Kapton shield shown after expelling dust.

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

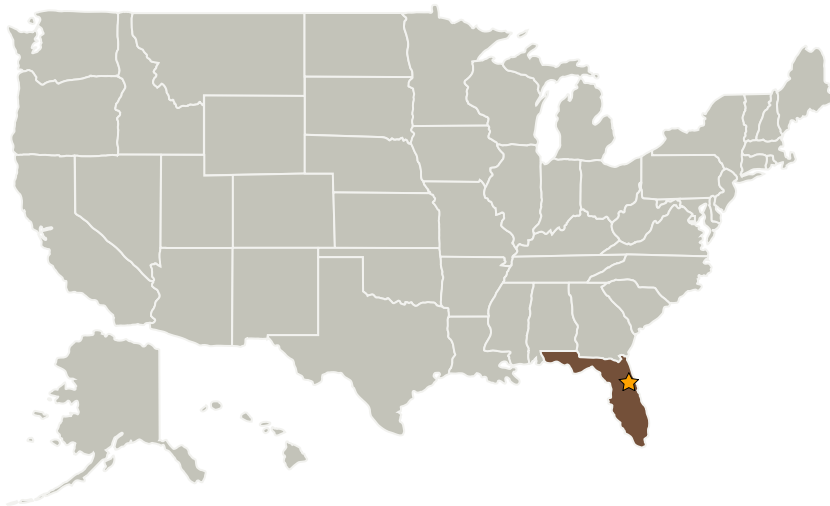
Center Independent Research & Development: KSC IRAD

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Engineering Services Contract	Supporting Organization	Industry	

Primary U.S. Work Locations

Florida

Project Management

Program Manager:

Barbara L Brown

Project Manager:

Nancy P Zeitlin

Principal Investigator:

Carlos I Calle

Co-Investigators:

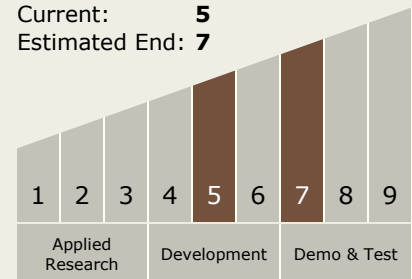
Michael R Johansen

Michael D Hogue

Paul J Mackey

Technology Maturity (TRL)

Start: 5
 Current: 5
 Estimated End: 7



Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - TX07.2 Mission Infrastructure, Sustainability, and Supportability

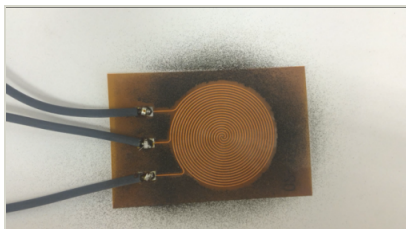
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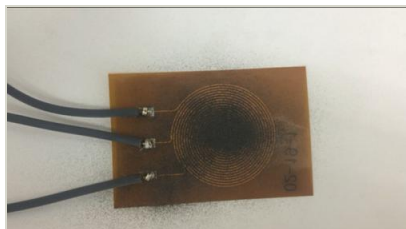
Images



Copper-on-Kapton Shield - After Operation

Copper-on-Kapton shield shown after expelling dust.

(<https://techport.nasa.gov/image/16565>)



Copper-on-Kapton Shield - Before Operation

Copper-on-Kapton shield shown before operation, covered in dust.

(<https://techport.nasa.gov/image/16564>)



Preliminary Prototype of Lunar Configuration

Early Prototype of EDS Lunar Experiment shown with Glass Shield and Solar Cells.

(<https://techport.nasa.gov/image/16566>)

Technology Areas (cont.)

- TX07.2.5 Particulate Contamination Prevention and Mitigation